Attachment 15
World Wide Web

The NGS Aeronautical Survey Program Web Site can be accessed at ***http://www.ngs.noaa.gov/AERO/aero.html*** This web site provides access to documentation and other information for performing airport surveys. The site also provides survey tracking information and links to the NGS Home Page, CORS Data Page, and Survey Station Data Sheets Page.

Aeronautical Survey Program Home Page

http://www.ngs.noaa.gov/AERO/aero.html

NGS Home Page:

The address for NGS' World Wide Web site is: ***http://www.ngs.noaa.gov*** There NGS presents a wealth of information on its data products, software programs, and user services, as well as links to other helpful sites on the Web.

NGS Home Page

http://www.ngs.noaa.gov

CORS and IGS Ephemeris Data (***http://www.ngs.noaa.gov/CORS/***):

Information on the National CORS system and access to CORS and Precise Ephemeris data downloads are available on the NGS web site. Use the "User Friendly CORS" utility to download customized RINEX data sets and IGS ephemeris. The latest coordinate files and other metadata for each CORS site is also available. The "Data Availability" feature can be used to determine if a CORS site is missing data for a particular time period.

USCG Navigation Center, GPS web site

(http://www.navcen.uscg.mil/gps/default.htm) Provides information on the status of the GPS constellation and provides NANU message postings and notices for outages at WAAS and DGPS sites.

PAGE-NT:

PAGE-NT is a menu-driven suite of programs used to process GPS data and is suitable for projects requiring the highest accuracy. A User's Manual, the software, and sample data set can be downloaded from the NGS anonamous ftp server:

ftp ftp.ngs.noaa.gov
login: anonamous
passwd: your complete email address

Once logged on, go to the /pub/ngs22/data1 directory and download all the files using binary transfer mode. The input1 and results1 directory contain the sample data sets.
Follow the setup instructions in the PAGE-NT User's Manual.

ADJUST:

The ADJUST and ADJUST UTILITIES software package can be downloaded from the NGS home page (http://www.ngs.noaa.gov) by accessing the "PC Software" link. Check the web page for the latest version of each program.

ADJUST

Performs a least squares adjustment on horizontal, vertical angle, and/or GPS observations. The program comprises six data checking programs in addition to the adjustment software. This software package has numerous options, such as choice of ellipsoid, and includes sample input data. Also available is the source code.

ADJUST UTILITIES

Suite of programs that are used in conjunction with PC program ADJUST. This group of programs includes:

BBACCUR which provides a formatted listing of the external and internal accuracies which have been computed by program ADJUST-- sorted in numerical ascending order of external accuracy. Output from program ADJUST, run with accuracies, is used as input.

CLUSTER used to identify geodetic stations which are common to two data sets with respect to name or a given position tolerance.

ELEVUP creates a bfile which combines the bfile output from the constrained horizontal adjustment with the bfile output from the constrained vertical adjustment. This new bfile contains *80* records with adjusted positions from the horizontal and *86* records with the ellipsoidal heights from the horizontal adjustment and the orthometric heights and geoid heights from the vertical adjustment.

ELLACC which computes ellipsoidal height order and class for a project. Output from program ADJUST, run with accuracies, is used as input.

MAKE86 which adds *86* records to the bfile. If the existing *80* records contain orthometric heights, these are added to the new *86* records.

MODGEE scales the standard errors assigned to the observations in the gfile. Input is a gfile and the scaling factor.

QQRECORD adds qq records to the Afile (used by program ADJUST) to compute accuracies for all observed lines. Either the gfile (for GPS projects) or the bfile (for classical terrestrial projects) can be used as input.

Other Software Programs:

Below is a select listing of other software that is currently accessible through the Web. For the full and most recent list of NGS programs, visit the NGS PC Software web page. On-line interactive versions of some of these programs are available in the NGS Geodetic Tool Kit (http://www.ngs.noaa.gov/TOOLS/).

COMPGB

Tests the consistency and compatibility of the Blue Book B file (GPS project and station occupation data) and G file (GPS vector data transfer file).

CR8BB

Reformats GPS project information to fit the requirements of the National Geodetic Survey data base. The file created, which is called the B-file, contains project information, station information, and survey measurements. The CR8BB software functions independently of the type of GPS receivers used in a project.

CR8SER

Extracts data from GPS Blue Book G file to create a station serial number file (serfil) for GPS observations.

DDPROC

The DDPROC Program organizes control point descriptions in accordance with the National Geodetic Survey's description file (D-FILE) format.

DSWIN

DSWIN is windows based software for Data Sheet view and extraction. It displays a list of county names as found on your CD-ROM. Click on a county and a list of stations appears. Click on a station from the list and a data sheet appears. You may save the data sheet to a file or print it. The search feature allows for filtering the station list by: Point Radius, Min/Max Box, Station

Name, or PID. You may also filter by type of control, such as 1st order bench marks only

DSX

Digital Data Sheet (DSDATA) extraction program. Extracts individual of groups of data from a DSDATA file. Includes options to extract by Station Identifier, Station Name, Area, and more. Also includes utilities for manipulating the data such as joining two of more DSDATA files or splitting a DSDATA file into smaller files. cost: Free with purchase of DSDATA.

GEOID99

Computes geoid height values for the conterminous United States, Alaska, Puerto Rico, Virgin Islands, and Hawaii. Suitable for conversion of NAD83 GPS ellipsoidal heights into NAVD88 orthometric heights.

HTDP

This horizontal time-dependent positioning software program allows users to predict horizontal displacements and/or velocities at locations throughout the United States. This software also enables users to update geodetic coordinates and/or observations from one date to another.

INVERSE3D

Program INVERS3D is the three dimensional version of program INVERSE, and is the tool for computing not just the geodetic azimuth and ellipsoidal distance, but also the mark-to-mark distance, the ellipsoid height difference, the dx, dy, dz (differential X, Y, Z used to express GPS vectors), and the dn, de, du (differential north, east, up using the FROM station as the origin of the neu coordinate system). The program requires geodetic coordinates as input, expressed as either: 1) latitude and longitude in degrees, minutes, and seconds or decimal degrees along with the ellipsoid heights for both stations, or 2) rectangular coordinates (X, Y, Z in the Conventional Terrestrial Reference System) for each station. The program works exclusively on the GRS80 ellipsoid and the units are meters. Both types of coordinates may be used in the same computation. The program reads input geodetic positions as positive north and positive west.

LOOP

Determines the loop misclosures of GPS base lines using the delta x, delta y, delta z vector components computed from a group of observing sessions.

Outline for Processing
Airport Geodetic Control Surveys
with PAGE-NT

1. Place Raw data files (zip format o.k.) in the following directory:
   `:\ProjectName\RawData\DOY\` Project Name is two-letter state ID, plus ANA
   DOY = Day of Year of Observation Files

2. Place RINEX data files, TEQC summary file, and precise orbit files (.SP3 format) in the following directory:
   `:\ProjectName\RinexData\DOY\`

3. Ensure the latest sitecors.bin, siteigs.bin and ant_info.* files are in the `:\pnt*\` directory.

4. Create a SERFIL and place into the directory: `:\ProjectName\serfil\`
   Create a GFILE directory: `:\ProjectName\gfile\`

5. Establish a session processing outline based on the procedures in section 5, vol. I, of the General Specifications for Aeronautical Surveys. Create a directory for each processing session:
   `:\ProjectName\DOY\DOYS\` S = Processing session letter

6. Process each session following the procedures in the PAGE-NT documentation.
   - Use the latest ITRF coordinates for the Antenna Reference Point (ARP) [or monument of applicable] of each CORS station.
   - Ensure the proper antenna height (monument to ARP) and model number is input in the station information menus.
   - OMIT the PACS station from the triple difference solution for the PACS to UNKNOWN sessions and ensure you enter the proper (derived mean) coordinates for the PACS into the station information menu.
   - Use the default meteorological values.
   - Put in the proper session letter for the session (Merge RINEX Files screen).
   - Turn off Tropospheric Unknowns for stations if required (Baseline Processing Options screen: Off = Fix = Not Highlighted; On = Solve = Highlighted in Blue [default]).

7. To run a L1 solution, first run a L3 solution. If the results are satisfactory, rename the output file "combined.sum" to "combinedL3.sum". Return to the Baseline Processing Options screen and select "L1" for the frequency of solution. Save the change before exiting the menu. Select check box 6 (only) under the RUN menu to run another combined solution. Rename the output "combined.sum" file "combinedL1.sum".

8. Review the combined.sum, float.rms, and fixed.rms files for each session. View plots and other files as necessary to analyze the processing session.

9. Create a GFILE for each session by running SINEX2G under the Utilities menu. Ensure the gfile.inp file is correct before each run. Save the individual GFILE for each session by naming it DOYSgf and saving it in the gfile directory or processing directory for the session. Run

SINEX2G again, appending the session GFILE to the project GFILE by editing thegfile.inp file to save the file in the `:\ProjectName\gfile\` directory with the name "gfile".

10. Submit a hard copy of the processing scheme and a spreadsheet showing the positions and X,Y,Z value differences between sessions for each station. If requested by NGS, also submit hard copies of the following files (for each session) with the processing report.
    - combined.sum, combinedL3.sum, combinedL1.sum
    - float.rms
    - fixed.rms

11. Edit the "#/File Types To Delete During Clean Up" section of the default.txt file to delete only the following files, then run "Clean Up Output Directory" from the Run menu. Submit all of the remaining data in the `:\ProjectName\` directory and subdirectories on CD-ROM or 100 MB Zip disks to NGS with the project report.

    Files to be DELETED:
    - *.00
    - *.dat
    - *.scn
    - *.prn
    - *.out
    - *.pom
    - *.new
    - eclipse
    - sum-*.flt
    - sum-*.fix
    - *.sp3
    - *.99o
    - *.99n

12. Place copies of the following files that were used during vector processing in the `:\ProjectName\` directory for submittal:
    - ant_info.*
    - sitecors.bin
    - siteigs.bin
    - default.txt (template)
    - gfile.inp (template)

NGS Procedural Outline for Adjusting GPS Data

(for Airport Geodetic Control Surveys)

This outline should be used to supplement the guidance in Section 6.0, vol.I, of the General Specifications for Aeronautical Surveys.

1. Complete PAGE-NT processing:
   - -Ensure all fixed coordinates used in processing were correct.
   - -Ensure Aup@ offset values for each station are equal to the monument to Antenna Reference Point (ARP).
   - -Ensure all PFR plots are acceptable.
   - -Ensure RMS values in COMBINED.SUM files are acceptable.
   - -Ensure all redundant vectors and multiple occupied station results check within 3cm/5cm of each other.
     - -show comparisons using a spreadsheet.

2. Create input files:
   - -Use the combined Gfile created in PAGE-NT
     - -Ensure all vectors are included in the file.
     - -Ensure there are no duplicate or misspelled station ID's;or mismatched serial numbers.
     - -Check B record, column 52-53 for proper coordinate system code (contact NGS)
   - -Make an Afile using program CRAFILE or by editing a previous Afile.
     - Recommended II and MM records-

```
II159999999
MM3NYnewbb
```

   - -Make a Bfile using program CR8BB, The Bfile must match the SERFIL, Gfile, and Dfile.
     - Tips for using CR8BB for windows-
     - -Use tab key to move to each data entry window
     - -Input text using upper case letters
     - -Input the observed meteorological values
     - -Create *86* records

3. Format and check Bfile:
   - -Manually edit Bfile into proper format:
     - -Insert GPS Survey Method Code >4: into *12* record column 76
   - -Run checking program COMPGB; do not continue adjustment unless all errors are corrected
   - -Run Bfile format checking programs

Substitute CTCORS for CORS below if applicable

4. Run a Free Adjustment (ADJUSTMENT 1):
   - Afile- Constrain the NAD 83 position and ellipsoid height (EHT) of one CORS station.
     - -Use the CORS station that is centrally located in the project area, or which was the reference station for most of the CORS to PACS vectors.
     - -Save copies of each Afile used- Name AAFILE.1" etc.
   - Bfile- Use clean Bfile from step 3 as input.
   - Output- Name output file ADJOUT.1
     - -Rename output Bfile BBOUT.1
     - -Analyze results, review residuals on vector components (all less than 3-5cm?)
     - -Check the agreement between the computed and adjusted positions of other CORS stations used in the project

5. Run a Horizontally Constrained Adjustment (ADJUSTMENT 2):
   - Afile- Constrain the NAD 83 position and EHT of all CORS stations used
   - Bfile- Use output Bfile from ADJUSTMENT 1 (BBOUT.1)
   - Output- Name ADJOUT.2; review results
     - -Use a spreadsheet to compare coordinates with NGS published (match 5cm hor., 10 cm eht?)
     - -Rename output Bfile BBOUT.2; (Basis for final Bfile)

6. Run a Supplemental Constrained Adjustment (ADJUSTMENT 3):
   - -This adjustment is for comparison only, use results from ADJUSTMENT 2 for further adjustments and final results.
   - Afile- Constrain NAD83 position and EHT of all HARN and CORS stations used
   - Bfile- Use BBOUT.1 again as input
   - Output- Name ADJOUT.3; rename output Bfile BBOUT.3; review results

7. Run a Free Adjustment with Accuracies (ADJUSTMENT 4):
   - Afile- Run program QQRECORD to add QQ records to AFILE.1 (output AFILE.4)
   - Bfile- Use BBOUT.2
   - Output- ADJOUT.4
     - -Run program BBACCUR to obtain a listing of the length relativeaccuracies
       - -Output- ABBACC.OUT@; review results
     - -Run program ELLACC to obtain a listing of EHTaccuracies
       - -Output- AELLACC.OUT@; review results
       - -Manually edit the mode EHT order and class code into columns 54-55 of each *86* record of BBOUT.2

The following two adjustments are performed to obtain orthometric heights to be inserted into the output Bfile from ADJUSTMENT 2

8. Run the latest version of NGS GEOID software to insert geoid heights into the Bfile:
   - Input- BBOUT.2
   - Output- GEOID.OUT

9. Run a Free Vertical Adjustment (ADJUSTMENT 5):
   - Afile- Constrain the NAD83 horizontal position of one CORS station and the NAVD88orthometric height of the Abest@ (center of project, high quality) benchmark
   - Bfile- Use GEOID.OUT for input
   - Output- Name ADJOUT.5; rename output Bfile BBOUT.5
     - -Review orthometric heights with published NGS values (agree w/in 15cm?)
     - -Use spreadsheet or table to show the comparison results. Note any bench marks that werenot constrained in ADJUSTMENT 6

10. Run a Constrained Vertical Adjustment (ADJUSTMENT 6):
    - Afile- Same as ADJUSTMENT 5, constrain additional orthometric heights of benchmarks that worked well in the Free Vertical Adjustment
    - Bfile- Use GEOID.OUT for input
    - Output- Name ADJOUT.6; rename output Bfile BBOUT.6; review results and rerun using different constraints in the Afile if necessary.
11. Run program ELEVUP to transfer orthometric heights from ADJUSTMENT 6 to the final

Bfile:
Input vertcal Deck- BBOUT.6
Input horizontal Deck- BBOUT.2
-Name the final Bfile %%%%FNL.BBK (where %%%% is a unique ID for the adjustment)
-rerun checking programs on the final Bfile to check for format errors
-double check values in *80* and *86* records against ADJOUT. 2 and ADJOUT.6
-rename GFILE to %%%%FNL.GFL

12. Run checking programs on the final Bfile and correct errors, explain any unresolved error messages in the project report:
-COMPGB
-NEWCHKOB
-OBSCHK
-OBSDES (matches Bfile with description file)
-CHKDES (checks description file for format errors)

13. Write the final project report and submit the following digital files (and paper copy if requested by NGS) in a `:\ProjectName\Adjust\` directory (Create an `%%%%\Adjust\` subdirectory for each grouping of airports adjusted together, where %%%% is a unique ID created for the adjustment group):

-ADJUST Files:
%%%%FNL.BBK
%%%%FNL.GFL
AFILE.*
ADJOUT.*
BBIN.* (1st Bluebook)
BBOUT.*
BBACC.OUT
ELLACC.OUT
GEOID.OUT
SERFILE

-Output Files From Checking Programs - Explain Error Messages in Report:
COMPGB.OUT
NEWCHKOB.OUT
OBSCHK.OUT
OBSDES.OUT (Checks description files)
CHKDES.OUT (Checks description files)

-Place a copy of the final Bfile, Gfile, and Dfile in a `:\ProjectName\FinalFiles\` directory.

Tennessee ANA Survey 1999
Vector Processing Results

Paris Henry County Airport (HZD) - Day 244

CORS - mem2

	Observed ITRF Coordinates					
PACS - HZD A	**X**	**Y**	**Z**	**SOLN**	**RMS**	**KM**
244A	138517.6508	-5157909.9332	3736955.8065	L3X	0.0146	172
244B	138517.6602	-5157909.9284	3736955.8076	L3PFX	0.0170	
difference	-0.0094	-0.0048	-0.0011			
MEAN	138517.6555	-5157909.9308	3736955.8071			
SACS1 - FAA HZD A						
244F	138244.3948	-5158611.2409	3735995.7541	L1X	0.0057	1
244G	138244.3946	-5158611.2392	3735995.7494	L1X	0.0073	
difference	0.0002	-0.0017	0.0047			
SACS2 - HZD C						
244F	138364.7295	-5158170.6200	3736597.6080	L1X	0.0057	0.5
244G	138364.7285	-5158170.6243	3736597.6115	L1X	0.0073	
difference	0.0010	0.0043	-0.0035			

	Adjusted vs. Published NAD 83					
HARN - GPS 15	**X**	**Y**	**Z**			
244C obs. (NAD83)	145521.9648	-5141684.5452	3758877.3789	L3X	0.0113	28
published. (NAD83)	145521.9690	-5141684.5610	3758877.3980			
difference	-0.0042	0.0158	-0.0191			
BM1 - F 181	**NAD 83 EHT (m)**	**NAVD 88 (m)**				
244D obs.	144.223	172.572		L3X	0.0116	22
published	N/A	172.628				
difference		-0.0560				
BM2 - Y 161	**NAD 83 EHT (m)**	**NAVD 88 (m)**				
244E obs.	94.516	122.698		L3X	0.0129	39
published	N/A	122.739				
difference		-0.0410				

Comments: 12 minute gap in CORS data from 1318-1330
GPS 15 also observed in session 242A -see sheet2 for vector comparison

ITRF Coordinate Comparison for Multiple Occupied Stations
HARN and Bench Marks

ITRF vector comparison for GPS 15-

	Observed ITRF Coordinates					
HARN - GPS 15	**X**	**Y**	**Z**	**SOLN**	**RMS**	**KM**
244C	145521.3912	-5141683.0467	3758877.2319	L3X	0.0113	28
242A	145521.3883	-5141683.0334	3758877.2145	L3PFX	0.0152	191
Difference	0.0029	-0.0133	0.0174			

ITRF vector comparison for GPS 32-

	Observed ITRF Coordinates					
HARN - GPS 32	**X**	**Y**	**Z**	**SOLN**	**RMS**	**KM**
254C	90432.9992	-5169962.2991	3721755.0682	L1X	0.0099	13
265C	90432.9988	-5169962.3238	3721755.0829	L3X	0.0099	50
266C	90433.0042	-5169962.3131	3721755.0756	L1X	0.0085	17
Max Difference	0.0054	-0.0247	0.0147			

ITRF vector comparison for ...-